Introduction

9629.2
P442
Bridgeport
Library

When the original version of this book was produced in 1972, there were few hints of the problems ahead for motorists. Although emissions controls were beginning to come into use to help meet the increasingly stiffer government regulations, their future complexity was not even dreamed about. Our car builders were busily producing full-size cars in prodigious quantities, while the compact cars were largely upstarts from foreign shores. And it didn't matter much if your car got 9 or 15 miles to the 50¢-gallon of gas, just so it performed adequately at whatever speed you felt like traveling.

Our first edition stressed the need for the automotive do-it-yourselfer to keep his engine in top tune, largely from a standpoint of the best possible brute performance rather than fuel economy per se. It was a short-lived age of free motoring spirit — and hang the future.

However, now that future has caught up with us, or rather we with it. The initial wave of wide-spread fuel shortages and resultant gas station lines were scary times but were merely a harbinger of the problems that would come.

Lines went away when the oil embargo was lifted, but then the price of gasoline took its first upward strides. By then, noises were being made of a nationwide 55-mph speed limit and our manufacturers began scurrying to define the parameters of the small cars they felt had to be produced.

Now, big cars have gone the way of the dinosaurs. The "double-nickel" is a fact of life. The big V-8 engines we were once so proud of and so in love with are being phased out of existence as fast as 4- and 6-cyl. replacements can be readied. Automotive weight-saving is the race today among the manufacturers. Under the hoods of these shrinking vehicles are new hoses, lines, sensors, black boxes, on-board computers—all manner of gadgets to lower tailpipe emissions to levels thought impossible a few years ago. What the next eleven years will bring us is still anybody's guess; you can bet, though, that even more stringent regulations are on the horizon.

There never was a greater need for keeping your car at its performance peak than there is now, and here we mean *fuel economy performance, not out-and-out horsepower performance.* And this latest and timely revision of *How to Tune Your Car* shows and tells you how to do it.

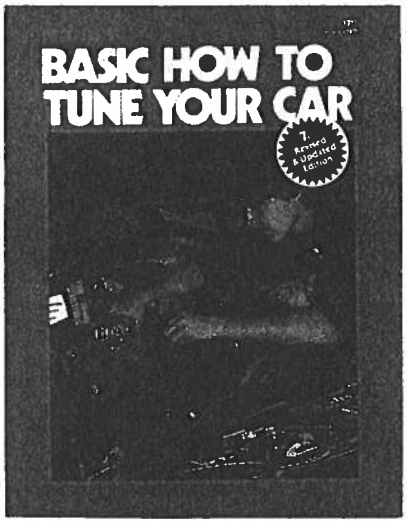
Even though the present automotive outlook differs totally from that predicted eleven years ago in our first edition, the closing admonition of that book's introduction remains true today: "We know you will find this book useful. Do your work carefully, slowly, with good equipment and quality parts, and you'll certainly enjoy finding out how to tune your car."

Library of Congress Catalog Card No. 75-15282

ISBN 0-89803-126-5

SPECIALITY PUBLICATIONS DIVISION

Lee Kelley/Publisher
Ray Hill/Editorial Director
Linda Sargent/Managing Editor
Susie Volkmann/Layout/Production Coordinator
Eric Rickman/Photo Editor
Bud Samiljan, Barri M. Jones, Sue Miller-Blair/Copy Editors
Scott Volkman/Production Artist
Fern E. Cason/Administrative Assistant
Dawn R. Harrison, Joyce A. Coleman/Editorial Assistants



HOW TO TUNE YOUR CAR No. 7

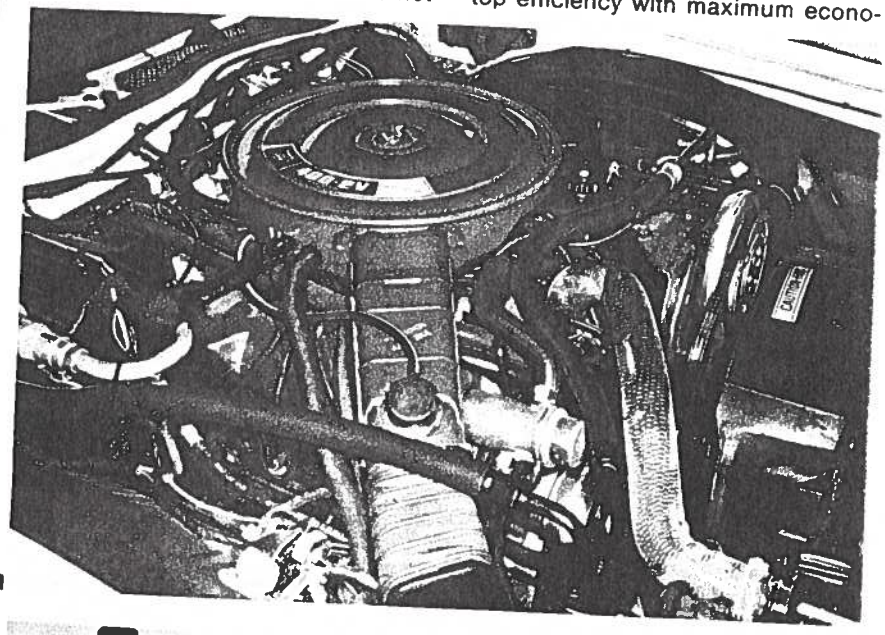
Edited by Spencer Murray and the technical editors of the Specialty Publications Division. Copyright © 1979 and 1983 by Petersen Publishing Co., 8490 Sunset Blvd., Los Angeles, CA. 90069. Telephone: (213) 657-5100. All rights reserved. No part of this book may be reproduced without written permission.
Printed in U.S.A. Published by Green Hill Publishers, Inc. 722 Columbus Street, Ottawa, Illinois 61350

Air Cleaner Maintenance

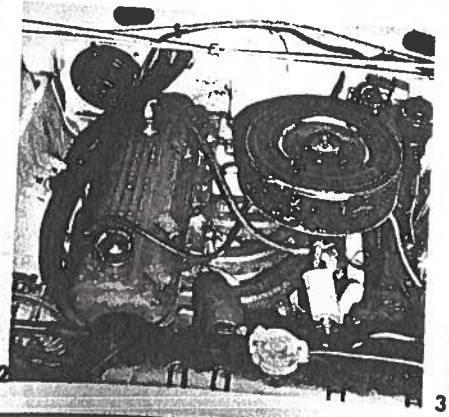
Although the carburetor air cleaner has been a part of the automobile almost from its beginning, the average motorist today tends to regard his with a rather high degree of suspicion. To many, it's just another unnecessary expense that happens to run up the garage bill just when they can't afford it. Points and plugs they can understand, but $6 for a crinkled piece of paper that's thrown away when it's discolored? Sure, back in Grandfather's day when paved roads were in a minority, everybody could understand the need for an air cleaner to filter the air drawn into the carburetor by trapping dust and dirt. All they had to do was to pull the unit apart and check the element inside after driving up and down the dirt roads for a few weeks —it was all there for them to see. But today's world with its vast network of paved primary, secondary and superhighways is quite a bit different—or is it?

Today's air is just as dirty as it was a quarter-century ago (if not more so); it's just that contributing elements have changed along the way. While filters are much more effective and don't visually show what they pick up, the original problem is there just the same and so is the air cleaner—nothing makes an engine run richer than a clogged or restricted air cleaner. But in recent years, design engineers have quietly elevated the status of the once-lowly air cleaner from that of an afterthought hung atop the carburetor to an integral part of the total underhood package whose function today is considerably more than simply filtering dirty air. So if you expect your engine to perform at top efficiency with maximum economy of operation, you've got to look at that air cleaner in a different light.

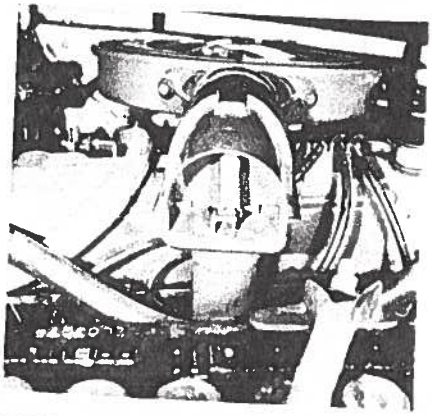
The engineers at Lincoln did just that quite a number of years ago, and in 1957 they came up with a device to control intake air temperature. They reasoned that by controlling the temperature of the air entering the carburetor, the choke would cut out faster and the air/fuel mixture would not vary according to extremes in outside air temperature. At the time, this advance was hailed primarily as a safeguard against carburetor icing that would make Lincolns so-equipped easier to drive. But the real value of preheating and controlling intake air temperature was not fully appreciat-



1



2



3

1, 2. Air cleaners have come a long way in the last few years. Today's version (1) is a multi-operational unit, a far cry from the simple filter element container of yesterday (2), whose function was simply to clean the air entering the carburetor.

3. You can check operation of Pinto air cleaner valve plate visually. It should close off inlet tube when cold and open it when engine reaches operating temperature.

4. To check function of vacuum-operated duct/valve units for binding or bent linkage, press valve plate down with thumb. It should return to position easily when released.

5. Keep valve plate and inlet entrance clean, as dirt/grease accumulation can cause plate or linkage to bind or stick.

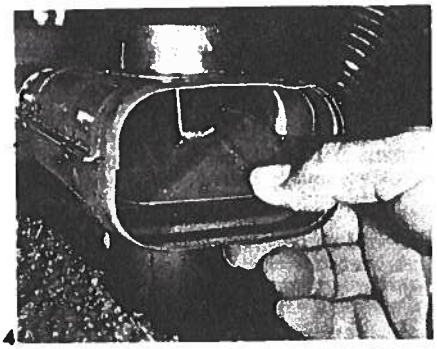
6. Temperature-operated duct/valve used in Pinto air cleaners is normally in the "heat on" position when engine is cold and engine compartment temperature is less than 100°F. As temperature reaches 135°F., valve plate drops to shut off manifold-heated air and let in cold.

7. Vacuum-operated GM air cleaner is shown here. With engine off, damper door (valve plate) blocks off manifold air (view A). As engine warms up, temperature sensing spring closes air bleed valve and vacuum causes spring to compress, closing off fresh air in favor of manifold air (view B). When underhood temperature reaches 85°F., air bleed valve begins to open and vacuum drops, modulating a mixture of fresh and manifold air (view D). At temperatures above 128°F., air bleed valve is completely open and damper door returns to original position, shutting off manifold air (view C).

ed until the drive to cut down exhaust emissions was mounted in earnest a decade later.

CLEANER COMBUSTION

The approach to cleaner combustion was that of leaning carburetor operation under conditions of idle and partial throttle, as well as leaning the choke calibration. The necessity for still leaner calibrations of both choke and carburetor operation resulted in a second look at the mixture control advantage of regulating intake air temperature; this regulation was found to permit still leaner operation without sacrificing engine response and good driveability. And so, engines modified for exhaust emissions control (or designed since) have been equipped with carburetor air preheating systems contained within the air cleaner.



4

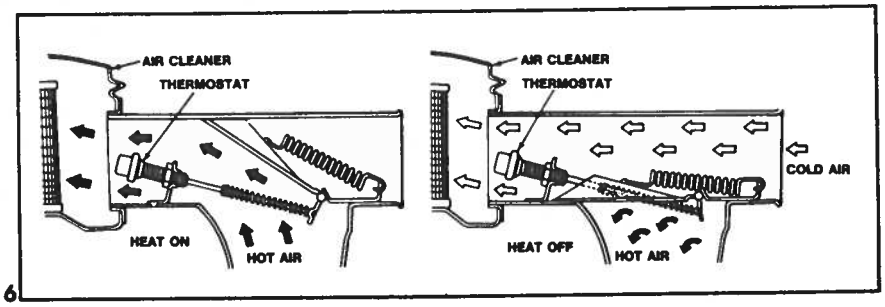
5

Basically, all domestic systems operate in essentially the same manner. Air for the carburetor intake is introduced directly from the exhaust manifold through a system of tubes or ducting and a baffle or shroud called a heat stove. Once this air heats up, a thermostat in the air cleaner snorkel opens a heat control valve or door to let in cooler air from the engine compartment while closing off the hot air from the heat stove. By varying the degree of heat control valve opening, the thermostat keeps the air entering the carburetor at whatever temperature the system requires for proper operation.

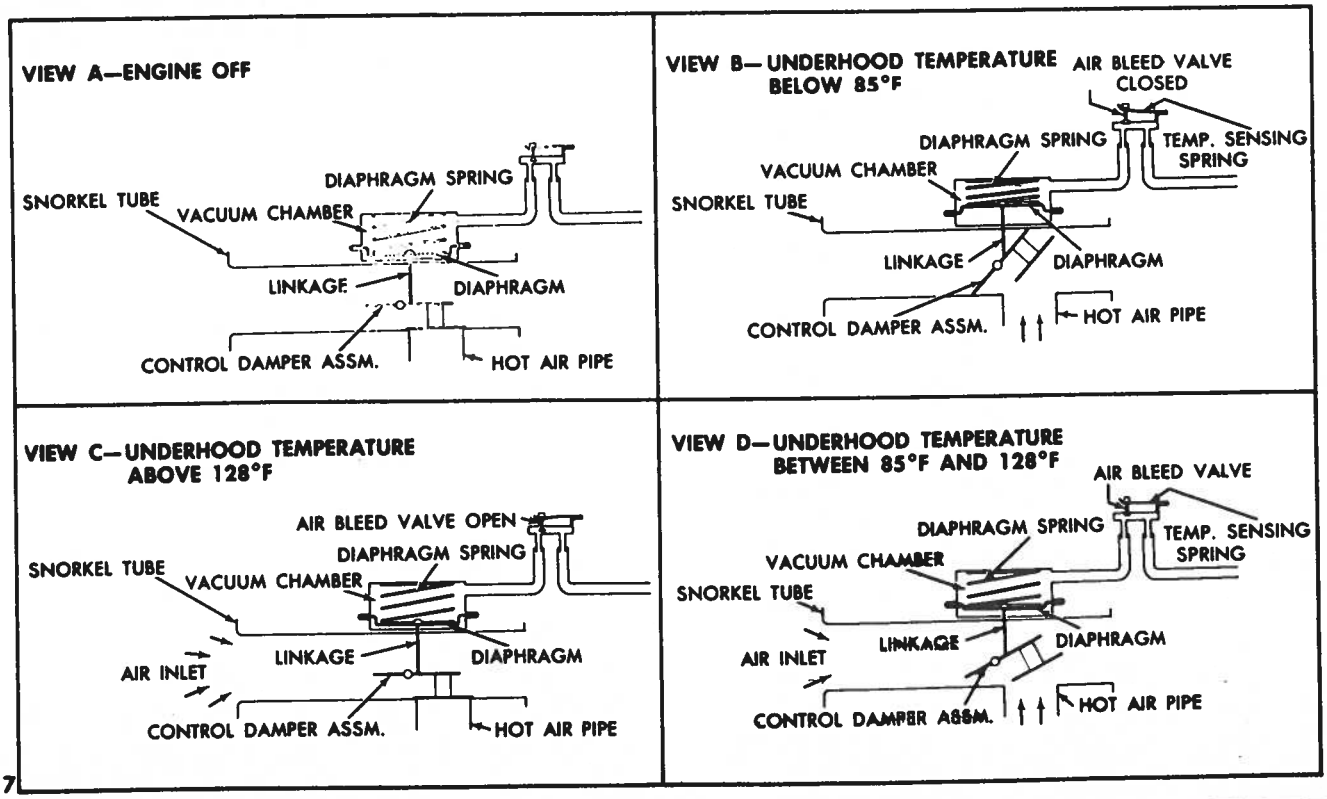
System design temperature varies according to manufacturer's requirements—Ford uses 90°F, Chrysler 100°F and General Motors engine compartment exceeds the design temperature level, the air cleaner cuts off manifold heat completely and draws intake air from the engine compartment. As a result, the carburetor will always receive warm air except for the first few minutes of operation when the cold exhaust manifolds are still in the process of heating up.

This mechanically operated system worked well enough, but as emissions level requirements became more stringent, system design necessarily became more sophisticated. Temperature-operated air cleaners have been superseded by vacuum-operated controls.

To give the carburetor additional air required during conditions of cold acceleration and keep the air/



6



7

fuel mixture from becoming too rich (thus giving off a higher level of emissions), engine vacuum was introduced as a control device.

CONTROL DOOR

The heat control door is operated by a diaphragm type vacuum motor and spring connected to a bi-metal temperature sensor located inside the air cleaner housing. On a cold engine that's not running, the diaphragm spring holds the door wide open. But once the engine is started and manifold vacuum builds up to 9 ins. or more, the vacuum motor overrides the spring, compressing it to close the heat control door and shut off air intake from the engine compartment.

The bi-metal temperature sensor acts as a modulator to mix the hot and cold air properly by controlling the position of the door. When air cleaner temperature rises above the system design temperature, the sensor opens a valve to bleed additional air into the vacuum line; if it falls below the design temperature, the air bleed is closed to let more manifold vacuum reach the vacuum motor. The result of this operation is to close off engine compartment air during conditions of high vacuum such as idle, cruise or deceleration, and to introduce it for maximum air flow during periods of low vacuum or acceleration.

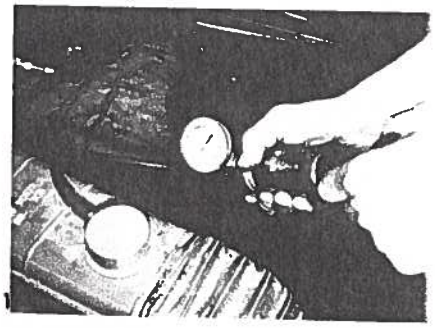
If there's a failure in the system, the heat control door will generally stay open, allowing only engine compartment air to enter. This shouldn't bother engine operation during periods of warm weather, but when the temperature dips you'll notice hesitation, surge, sagging or stalling. These symptoms mean that a quick check of the air cleaner's operation is in order before you blame the carburetor for being set too lean.

What can go wrong? Well, let's troubleshoot the air cleaner for a few minutes, as improper functioning of the system will affect both the emissions level and how the engine runs. If your car uses one of the mechanically operated temperature control systems, you can check its operation much as you would a cooling system thermostat. To do so, you'll need a bucket of hot water (100°F.) and a means of controlling the water temperature.

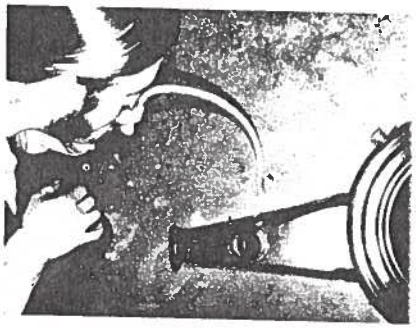
Before removing the air cleaner unit from the car, check the position of the heat control door in the snorkel—it should be closed to air from the engine compartment. Dunk the end of the air intake snorkel into the water far enough to cover the thermostat completely, wait a couple of minutes and then check the door position again—it should still be closed. Now increase the water temperature to about 135°F. and after allowing the thermostat a chance to work, check the door position—this time it should be fully open. If it isn't, check for a mechanical interference in the door's operation. If none is found, then the thermostat is not operating properly and must be replaced.

VACUUM SYSTEMS

Vacuum-operated systems are a bit more complicated to troubleshoot. If you suspect a malfunction, first look to make sure that all vacuum lines are in good order and correctly connected; a pinched or cracked hose may be at fault. Next remove the air cleaner unit from the carburetor and disconnect the vacuum diaphragm hose either at the



1



2

1,2. You can check operation of vacuum assembly with a hand vacuum pump, but if one isn't handy, suck on the vacuum hose and place tongue over hose end. Valve should open and stay open. If it doesn't open or if it opens and slowly closes while vacuum is applied, unit is defective and should be replaced.

3. Ford air cleaner uses a screw-on air inlet tube containing vacuum diaphragm, making replacement of faulty diaphragm simple but expensive. As this air cleaner fits Econoline van, diaphragm is on bottom and manifold inlet hose on top; passenger cars are just reverse. Chrysler and GM units are replaced by breaking spot welds.

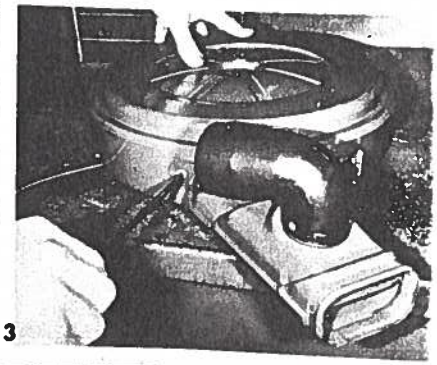
4. Mustang II uses zip tube between vacuum diaphragm unit and air cleaner. A hole in zip tube can cause faulty operation in cold weather as fresh air that's not supposed to be in the system would influence temperature sensor in air cleaner.

5. Bi-metallic sensor unit in Ford air cleaner controls bleed valve and can be checked by removing and placing in water about 80°F. while watching for slight movement of bi-metal spring.

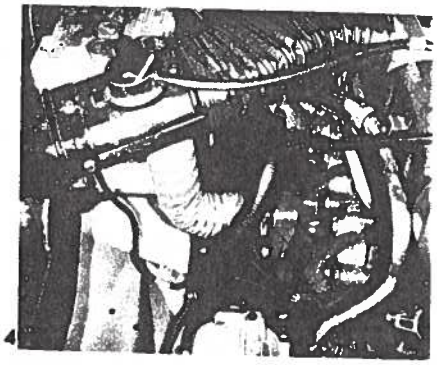
6. If you find it necessary to replace temperature sensor, be sure to install new switch in same position as the old one. Don't press down on center of new sensor while installing or you'll damage switch inside.

7. Newest addition to air cleaner function is the crankcase ventilation filter pack. This prevents oil and sludge from blowing back into air cleaner, fouling filter element and possibly seeping into carburetor.

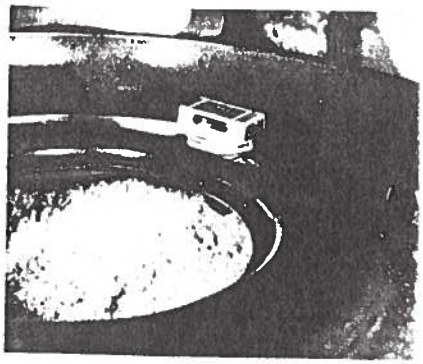
8. Manufacturers no longer recommend cleaning the filter element; replace when necessary after wiping inside of air cleaner with a cloth dampened in solvent.



3



4



5

sensor or vacuum diaphragm unit. Use a hand-operated vacuum pump to apply about 10 ins. of vacuum to the diaphragm. If a hand pump is not available, you can accomplish the same thing by applying your mouth to the vacuum hose. This amount of vacuum should cause the heat control door to close completely. To make certain that there are no vacuum leaks, pinch the hose or clamp it off to trap the vacuum in the line. If the door moves from its closed position, you've got vacuum leakage in the diaphragm and the diaphragm assembly must be replaced.

The sensor unit can be removed and tested in hot water like a thermostat. This will show if it is unseating the bleed valve properly, but a more convenient way to check if it's working correctly is to reconnect the air cleaner on the carburetor and start the engine. The heat control door should immediately close, but as the engine warms up it will begin to gradually open to let a mixture of heated and outside air enter. This will tell you whether or not the sensor is actually working, but it won't tell you if the temperature range of operation is correct. Naturally, you should not rule out the possibility of binding linkage in the heat control door's operation.

POSSIBLE DAMAGE

Experience would suggest that you're most likely to encounter problems with the air cleaner system if you (1) drop the unit on the ground, (2) fail to keep the air intake and heat control door free from dirt and grease buildup, (3) accidentally pinch the vacuum lines when replacing the air cleaner on the carburetor or (4) run it with a dirty filter element.

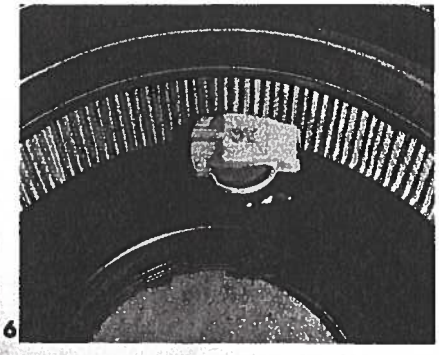
Dropping the unit can easily damage the diaphragm assembly, the temperature sensor or the connecting linkage between diaphragm and heat control door. Dirt and grease accumulation can prevent proper movement of the door, while pinching the vacuum lines can cause a leak or restrict the amount of vacuum applied. And an excessively dirty air filter element will not only distort the air/fuel mixture but it can also affect the temperature sensor's operation, as this unit is placed inside the filter's circumference and air must pass through it to reach the sensor.

Incidentally, late-model Ford and GM air cleaners are now equipped with a separate small crankcase ventilation filter pack. This acts to trap oil and other contaminants when blowby gases reverse their direction under heavy engine load and travel back through the PCV valve inlet hose into the air cleaner. While these filters can be cleaned and reused, they're not too durable and replacement is more effective once they become overly dirty. Unfortunately, many servicemen and drivers ignore this ventilation filter and in doing so, eventually reduce the effectiveness of the PCV system's performance.

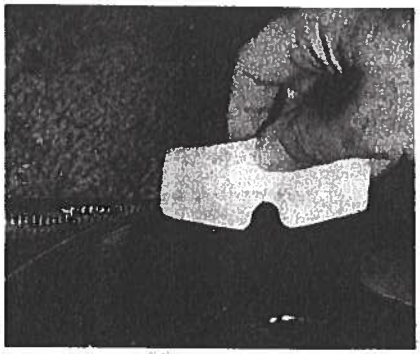
There's one other aspect of air cleaner maintenance of which you should be aware. Not too long ago, the entire industry used an all-metal air cleaner with an open-end snorkel to draw in air from the engine compartment. But some cars are now equipped with a zip tube or flexible connector to a fresh air inlet which draws air in from outside the engine compartment. In theory, at least, there are several advantages to use of the zip tube. Air entering the system can be prefiltered and, as a result, the heat control door is not subject to rapid accumulation of engine compartment debris and contaminants. But, as zip tubes are made of flexible plastic, they tend to crack and tear easily, especially near their plastic strap which connects the air cleaner unit to the fresh air inlet tube.

Depending upon the overall system design, a damaged zip tube can have either an adverse or no effect on heat control door operation. If the vacuum diaphragm used to control its operation is placed between the zip tube and bi-metal sensor, a tear in the tube is not much to worry about; but latest designs position both diaphragm and door in the fresh air inlet where the zip tube connects, instead of in the air cleaner snorkel. While this prevents accidental damage to the unit if the air cleaner is dropped, a tear in the tube means that engine compartment air will enter the system when it's supposed to be drawing in fresh air, leading to a temperature difference under certain conditions. During a cold morning start when the heat control door is closed to draw in manifold-heated air, colder air from the engine compartment enters the system, mixing with the warmer manifold air and lowering the temperature of the air reaching the bi-metal sensor. This will slow down proper system operation and lead to hesitation and stalling during engine warmup on very cold days. So keep a close eye on that zip tube for tears or cracks and repair any you find before they get out of hand.

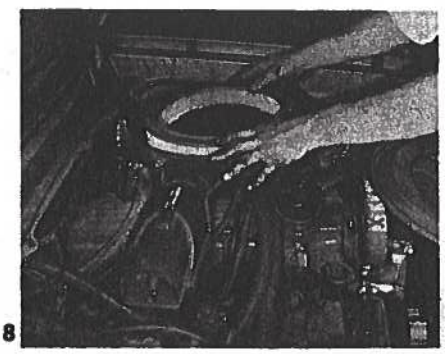
Today's air cleaner has a much more important role than ever before in determining how well your engine performs, and with even more stringent emissions levels down the road, it's likely to become even more sophisticated in design and operation. Don't overlook a complete check of the air cleaner whenever you tune your car; and should you encounter what appears to be a carburetor problem on cold morning starts, check the unit before you place the blame on the old 2-bbl. The carbs in use these days are so highly refined in operation that minor malfunctions in the many subsystems hung onto them—air cleaners, EGR valves, decel valves, etc.—are more likely to be the real cause of the problem. Keeping the air cleaner in good shape takes only a few minutes, but it'll pay off in miles of troublefree and economical driving.



6



7



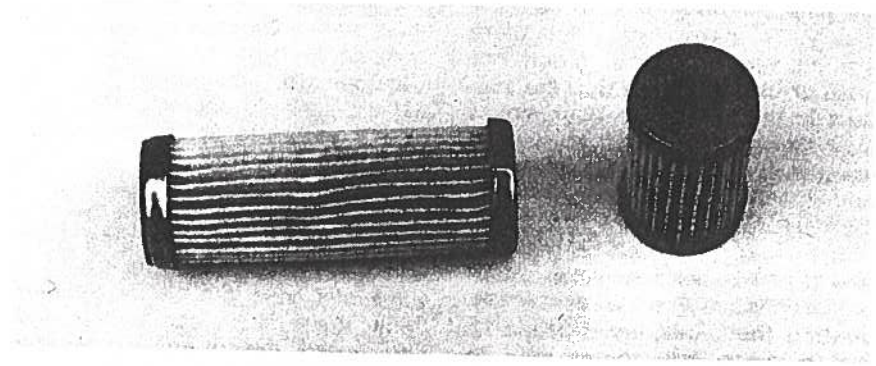
8

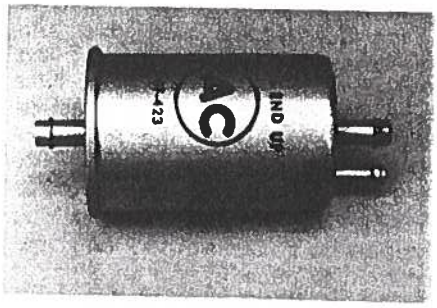
Fuel Filters

If you've ever had to troubleshoot a case of hard starting, surging and limited acceleration, you're probably well-aware that the problem can be caused by a dirty or plugged fuel filter; if not, you may even be blissfully unaware of its existence. After all, the gasoline refineries put out a good, clean product, don't they? Well, yes they do, but stop and think how many times and in how many different containers gasoline travels between the refineries and the time that it settles in your tank—and you'll see the need for filtering.

All automotive manufacturers today place a filter on the lower end of the fuel pickup tube in the gas tank. This prevents dirt, sediment and moisture from entering the fuel line and is nothing to concern yourself about unless someone should take a hearty dislike to you and fill your tank with water instead of gasoline. Normally, these pickup filters are self-cleaning and under all but abnormal conditions, they do the job without giving any problems.

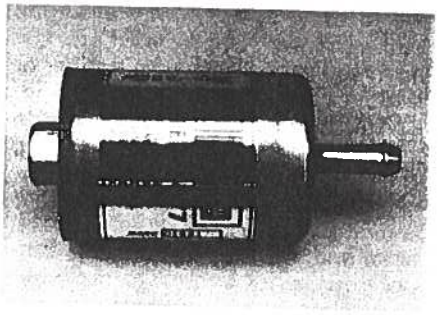
Older model cars used a fuel filter of ceramic or paper material seated in a glass bowl and positioned in the vicinity of the fuel pump. Sediment collected by the filter settled at the bottom of the bowl and unless otherwise disturbed, you could often run a car equipped with one





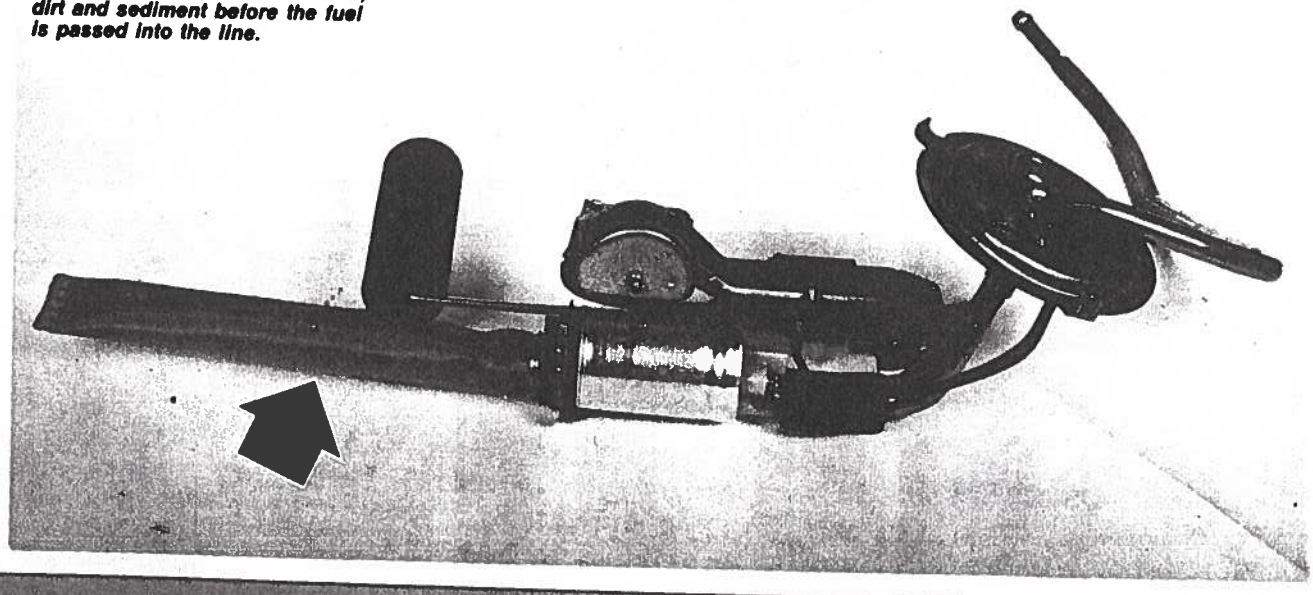
Disposable, pleated paper filters found inside carburetor fuel inlets of late-model GM cars should be changed every 12,000 miles or once a year.

Air-conditioned vehicles and other hot-running applications are often equipped with this type of inline fuel filter. Second fitting on outlet side accepts rubber tubing from the fuel tank, acts like a vent to prevent vapor lock.



GM's state-of-the-art filter is this laser-welded, stainless steel unit used on some 1982 4-cylinder applications.

A self-cleaning fuel filter is attached to the pickup tube in your gas tank and filters out moisture, dirt and sediment before the fuel is passed into the line.



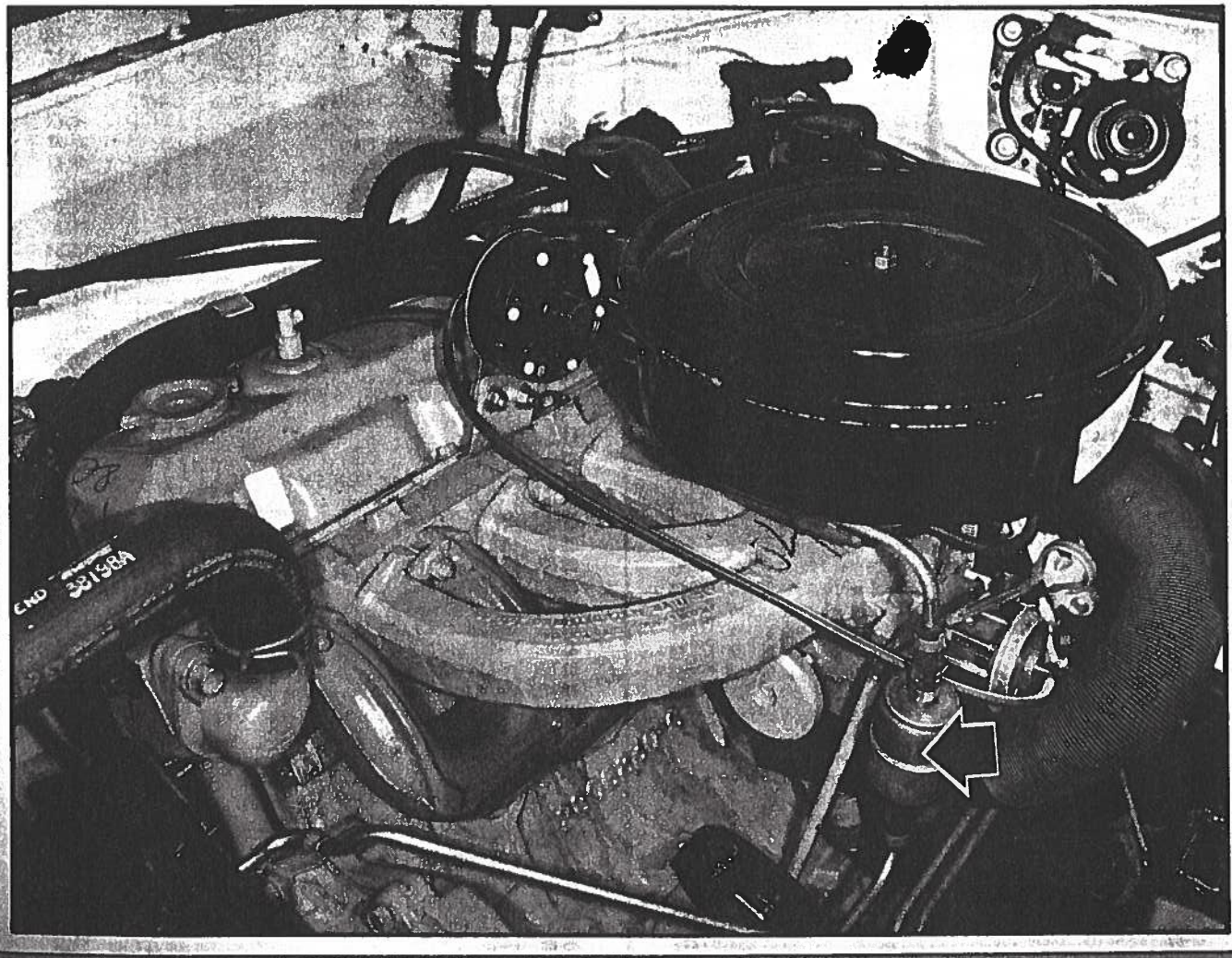
of these into the ground without ever touching the filter. We don't advise this procedure, however. It was (and still is) a good idea to periodically check the bowl and when sediment could be seen, to go ahead and clean the bowl and either replace the paper element or clean the ceramic one.

The trend to disposable or throwaway fuel filters began some years ago and they are now used on almost every car—domestic or import. The type used and their location differs according to model and manufacturer. Chrysler uses an inline filter with recommended replacement at 24,000 miles. On the Slant-6, the filter is located near the intake manifold and can be changed from under the hood, but placement on the V-8 engines is beside the fuel pump and best reached from under the car. Inline filters have an arrow on the case to indicate direction of flow and must be installed properly or the fuel won't pass through.

GM generally locates its fuel filters inside the carburetor fuel inlet these days. Pleated paper filters are used and the element is installed with its cupped end outward. A spring holds the element outward to seal it by compressing a gasket surface against the inline fitting. Don't lose or otherwise overlook this spring when replacing an element, as it's part of a bypass system that comes into play if the element plugs up. Fuel pump pressure will depress the spring sufficiently to let some fuel slip by the filter and the engine will continue running on unfiltered gas at speeds up to 50-60 mph. Beyond that (or at lower speeds and hard acceleration), you'll encounter surging. Carburetor inlet fuel filters should be changed at least every 30,000 miles or once a year.

Ford uses an inline fuel filter that screws directly into the carburetor fuel inlet and clamps to the fuel line. It's a one-piece disposable unit containing a magnetic washer to trap metal particles and prevent them from entering the carb. While these are also one-way flow units, their design is such that you can't possibly install one incorrectly. The exception to the rule here is the Holley/Weber 5200 used on Pinto and Mustang II; the fuel inlet on the air horn uses a plastic container holding a mesh screen, but the fuel filter is an inline type positioned between the fuel pump and carburetor—the only exception to the rule in the Ford line.

Which brings us to one final area of caution. Some carburetor designs still use a filter screen under the fuel inlet needle seat. This should be changed whenever you overhaul the carb. But if you make fuel filter replacement a regular part of your tune-up, very little if any contamination should reach this point and you won't need to overhaul the carb because of dirty jets. That alone can save you the cost of several fuel filters and the few minutes it takes to install one.



Chrysler Slant-6 engine uses an inline disposable filter (arrow) that's easily accessible for replacement without difficulty. Just unclip the fasteners at each end, remove and replace with the new filter. Arrow must point in direction of fuel flow.

Thanks to WALTER RUEFF BUICK, San Fernando, CA